

CAST-IRON PIER AT GRAVESEND.

At the Institution of Civil Engineers, on April the 8th, Sir John Rennie, President, in the chair, a paper was read by Mr. J. Baldry Redman, giving a description of the new cast-iron pier at Gravesend, just completed from his designs, and under his superintendence. After an introductory memoir, describing the rapid growth of steam navigation, and consequent increase of the town, and demand for greater accommodation, the paper gave an account of the mode of construction adopted, which was illustrated by drawings, and a model of the work by Mr. Salter. The pier is situated in front of the Terrace gardens, in a line with Harmer-street. The length is 250 feet, and it is supported upon twenty-two Doric columns of cast-iron, 28 feet long, weighing nearly ten tons each. The first tier is situate at high-water mark, and from thence there are three spans, of 50 feet each, to the pier-head, which is 90 feet long by 30 feet wide. Horizontal iron girders support the platform, and the external girders are inclosed by an entablature, which also forms the parapet; at the south end are solid abutments and wing-walls to support the approach, and stone offices with turrets flank the entrance. The first tier of girders is carried over the esplanade in front of the gardens, which is thus continued underneath the pier. The whole area of the platform is covered by a wrought-iron roof, boarded and slated, and supported upon coupled iron pilasters, with corrugated iron panels between, and the sides can be inclosed at will by shutters; sky-lights are introduced in the roof. The approach from the river is by a double flight of steps with landings to suit all states of the tide. A powerful light is exhibited from a cast-iron lighthouse, surmounting the junction of the roofs at the pier-head, which is supported upon a system of iron trussing, 43 feet in span; octagonal copper gas-lamps are suspended from the apex of the roof. This structure has been designed to meet the views of the conservators of the river, so as to offer but little obstruction to the navigation, and there is a clear headway of 8 feet underneath at high-water spring-tides. The comfort and convenience of passengers by steamers have been also materially consulted.

The paper described in detail the method adopted in getting in the foundations which was one of the chief features of the paper, as the method was novel, viz., by sinking cast-iron cylinders to a depth varying from 9 feet to 14 feet below the level of low-water mark of spring-tides, and keeping their tops always raised above high-water.

The ground was excavated from within them, and they were fitted with solid work to the level of low-water mark, where the columns were bedded on the stone bases; the work occupied two years in its construction, and has been since Easter Monday, open to the public.

A very ingenious machine was exhibited for making with perfect accuracy artificial teeth, gums, and palates: it is the invention of Mr. Tomes, who described its action and demonstrated its capabilities. A plaster of Paris cast of the gums having been obtained, a peculiar moulding composition, softened by heat, is pressed upon the cast and allowed to cool in that situation; it is then removed and reduced to the shape of the intended teeth, and if on trial this composition model is found to fit the mouth accurately, it is placed in the face-plate of the machine, and a perfect copy is obtained by the mechanical action of the revolving cutter or tool. The machine consists of three slides; two are placed vertically and move in two directions horizontally and vertically, but each in the vertical plane. Upon these slides is a plate of iron, to which is fixed the composition model and the substance in which the copy is to be produced; the two, therefore, partake of equal motion. The third slide is placed horizontally, and admits of horizontal motion only, but at right angles with the motions of the perpendicular slides. Upon this slide a tracer with a blunt point is permanently fixed, and parallel with it is a revolving cutting point or drill, by the three sliding motions the tracer is made to pass over the surface to be copied, whilst the drill is constrained to describe an exactly similar surface in the substance placed before it, and by the rapidity of its motion joined to the delicacy of

its action, copies with accuracy the most minute projections on the cast. In the specimen exhibited the finest filaments were accurately delineated on the ivory carving, and the machine was pronounced to be capable of adaptation to many other purposes beyond dental carving, for which it was designed and for which it has been entirely used by the ingenious inventor.

PROPOSED NEW BRIDGE OVER THE MENAI.

THE great national improvement involved in the establishment of a speedy communication by railway and steam-ships between London and Dublin, and Holyhead, being now in progress, and, as it is understood, sanctioned by the Government, powers for crossing the Menai by a bridge at the Britannia Rock, one of the wildest and most critical parts of the Swellies, have been introduced into the Chester and Holyhead Railway Bill now pending in Parliament.

The idea is by no means new. It appears to have first originated about the year 1783; the expressed object being to facilitate the communication with Ireland, and do away with the delay and danger of the ferry called "Bangor Ferry." The inhabitants of Carnarvonshire, more particularly those of the county town (where the principal shipping interests of the coast were then located, but not as now incorporated by Act of Parliament) took alarm at what they considered a dangerous obstruction to the navigation of the Straits, and a bill being brought into Parliament for the purpose, it was strenuously opposed in the year 1784-5, and finally defeated in 1786. The question, however, was not set at rest, but still continued to be occasionally agitated, and in 1801 a survey of the Straits was made by the late Mr. Rennie, under the direction of Government, with the object of crossing them by a bridge; he reported in favour of the project, and proposed two plans of bridges, both arched and of cast-iron, and supported by pillars of masonry; one of a single arch at the side of the present suspension bridge; the other of three arches at the Swelly, Benlas, and Welltrog Rocks; and these plans being submitted to Mr. Jessop, an engineer of great celebrity, and to Dr. Hutton, the Royal Professor at Woolwich, were approved of by them.

Notwithstanding the reports of the most scientific men of their day, the Government never carried into effect their suggestions of arched bridges on piers of masonry. The Chester and Holyhead Railway company now propose to carry their road over the Straits at the Britannia Rock, a spot never proposed by former engineers, and by a bridge of two cast-iron arches, supported on piers of masonry, founded at low-water mark, of the following dimensions:—

Span of the arches from pier to pier.....	360 ft.
Height of ditto from high-water to the crown of the arches	105
Height from high-water to the springs of the arches	55
Clear space for headway under the arches	200

In width at a minimum height of 90 feet—

Width of middle pillar of solid masonry	130
Height of ditto	140
Width of side pillars	60 to 70

The Trustees of Carnarvon Harbour, as well as other parties concerned in the coasting trade, regard this proposed bridge as possessing all the defects and dangers of the arched bridges of former times, aggravated by its diminished space from pier to pier, by its increased mass of masonry, by its fixture in a most dangerous locality, and by other circumstances too numerous and particular to detail in this article.

Memorials to Government having been presented on the subject, engineers and nautical gentlemen nominated by them have been sent down to inquire particularly into the matter, and a meeting for this purpose took place at the George Hotel, near Menai Bridge, on the 25th ult. On the part of the Admiralty there were present Sir John Rennie and Mr. Rendel, engineers. The presence of a nautical man having been suggested by the trustees, Captain Vidal, R.N. of the surveying steamer *Styx*, was sent down about a fortnight back, and he has since been occupied in making a minute survey of the Swellies, and obtaining all pos-

sible information on the mode of navigating vessels there. The Chester and Holyhead Railway Company were represented by Captain Moorsom, R.N., and Mr. Robert Stephenson, the engineer, attended by Mr. Parker (of the firm of Parker, Hayes, Barnwell, and Twissden, of London, solicitors); T. H. Evans, Mayor of Carnarvon; H. P. Manley, Esq., collector of the Harbour Dues; R. A. Poole, Esq., of the firm of Messrs. Poole and Powell, solicitors of Carnarvon, with Mr. Poole, jun. appeared for the trustees.

The most particular attention was paid by the scientific gentlemen present to the statements of every person examined, and we believe the contending parties separated with the best feelings, and under the impression that their respective interests had been carefully considered, and would be duly protected.

In the course of the inquiry, Mr. Stephenson stated that he considered it perfectly practicable to construct cast-iron arches which should not be effected by the vibration of a railway. That he was not at present prepared with any plan of a suspension bridge which he considered unobjectionable as applicable to a railway. That the arches of the proposed bridge could be let down from above into their proper places, but that for this purpose the main or middle pillar of masonry must be at least of the height marked, viz. 130 feet, and in all probability more. That it would not be difficult to form it into two pillars by an arched aperture in the middle.

THE BOX TUNNEL.

CONSIDERABLE alarm having been excited by an account in the newspapers, of the fall of a quantity of stone from the top of the Box Tunnel, it seems desirable to give increased publicity to Mr. Brunel's report, as calculated to allay the fears of the public:—

"18, Duke-street, Westminster, April 7.

"Gentlemen,—I beg to lay before you a short statement of the circumstances attending the falling of a stone in the Box Tunnel, on the 24th ult. I should remind you that about 'a quarter' in length of the tunnel, near the east end, is cut through the natural rock, and is not lined with masonry. At the eastern extremity, a short distance was arched or lined subsequently to the completion of the tunnel. In the centre of this length of inclined tunnel is one of the large working shafts. During the winter, and particularly during the thaw after a severe frost, the surface of the rock, and some of the beds particularly, have always suffered in the immediate neighbourhood of the shaft and formerly also near the east mouth; but since the arch has been turned, for some short distance within the mouth, no further apawling or scaling of the stone takes place there. Down the shaft, however, the cold air descends, and for 50 or 100 yards on either side of the bottom of the shaft the most intense cold frequently prevails. During the past very severe winter, men have been constantly employed between the trains in breaking the icicles which form in and about the shaft, and knocking down apawls or loosened stones, and the effect of the shaft was found to be so mischievous that it has been determined to close it as soon as the frost would permit of the necessary masonry being built. Between the trains on the day in question a large stone which apparently had been loosened by previous work, fell, not from the roof, but from the side of the tunnel, near the shaft. It fell upon the rails, and the empty assistant engine, although signalled by the men employed at this work, ran upon it and was thrown off. This led to the delay of the succeeding trains. The accident was entirely the result of the severe cold, and owing to the open shaft. The shaft is now being closed. No effect has ever been produced upon any other part of the rock than that exposed to the direct action of the frost—formerly, near the mouth, and subsequently near the shaft. Such occurrences are by no means unfrequent consequences of severe frost in open cuttings either of railways, canals, or common roads, and are much more rare in tunnels. In the Box Tunnel the frost only reached, as I have said, a short distance either way from one shaft, and this will now be closed. It is altogether an incorrect statement which has been circulated, that there is anything peculiar